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(54) **MANAGING TRANSFER OF DATA IN A DATA NETWORK**

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(51) **Int. Cl.**

| | |
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| ***H04L 29/08*** | (2006.01) |
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(58) **Field of Classification Search**

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See application file for complete search history.

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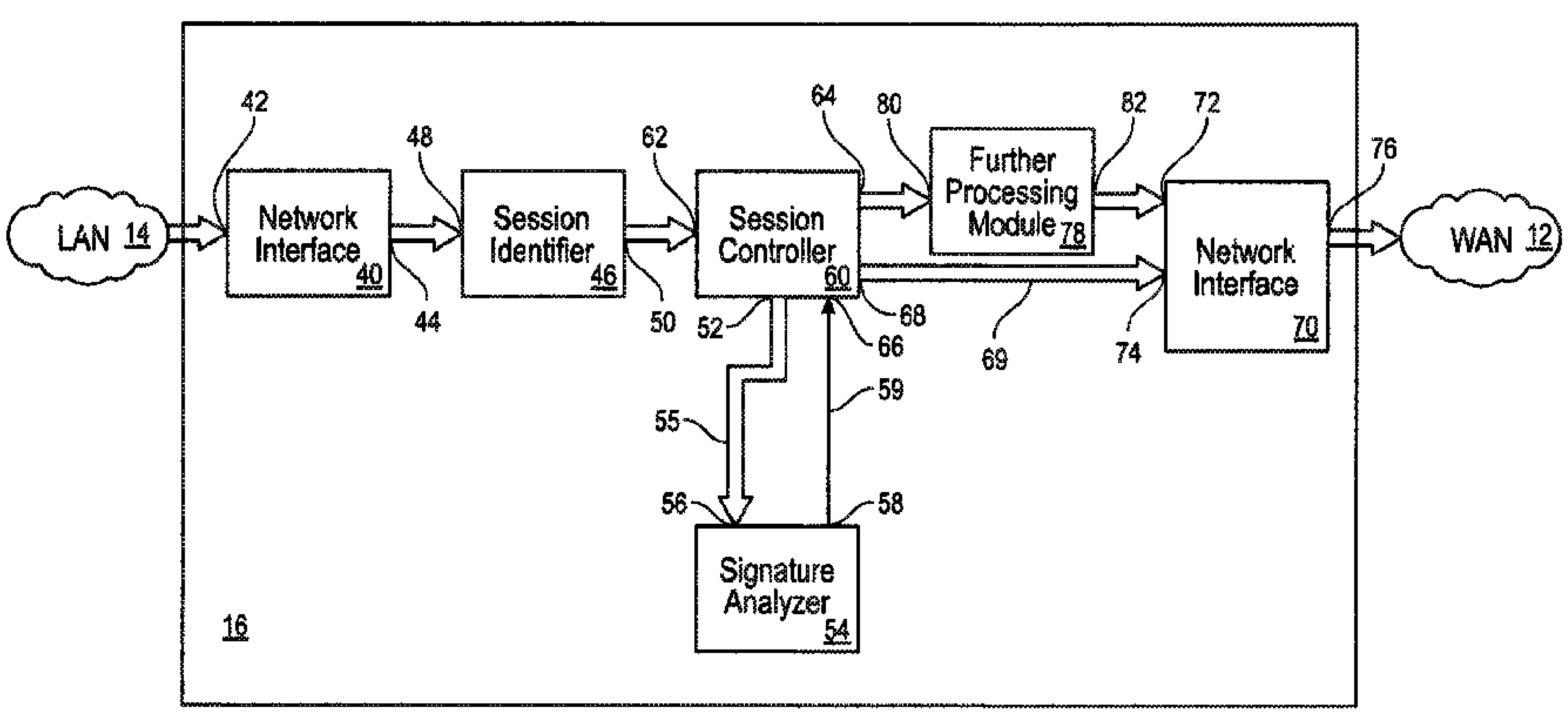
(57) **ABSTRACT**

A method and apparatus for managing a transfer of data in a data network identifies data associated with a communication session between a first node and a second node in the data network. Further processing of the communication session occurs when a portion of the communication session meets a criterion and the communication session is permitted to continue when the portion of the communication session does not meet the criterion.

**12 Claims, 8 Drawing Sheets**



**Related U.S. Application Data**

No. 13/250,285, filed on Sep. 30, 2011, now Pat. No. 8,856,884, which is a division of application No. 11/220,762, filed on Sep. 6, 2005, now Pat. No. 8,166,547.

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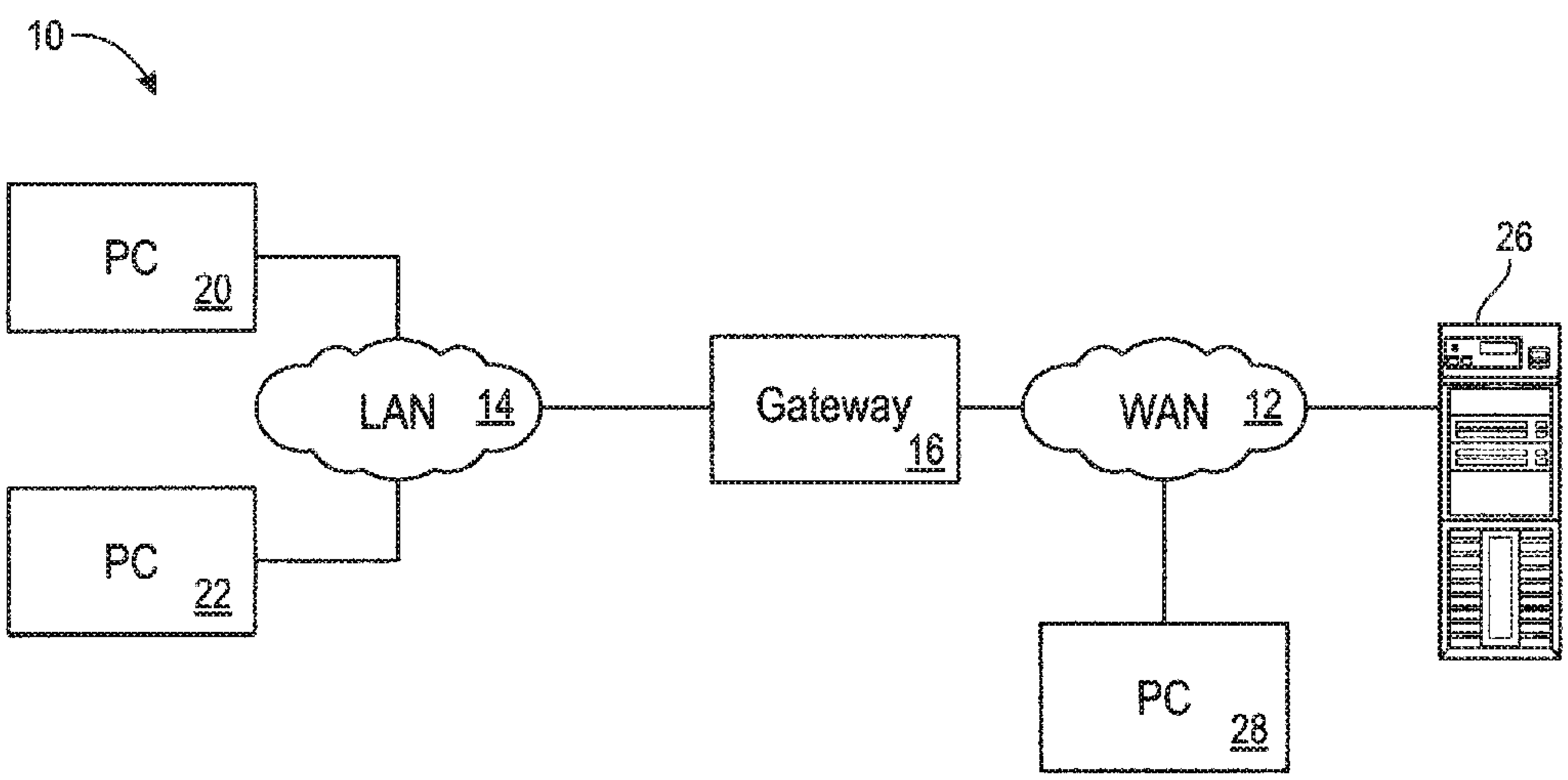


FIG. 1

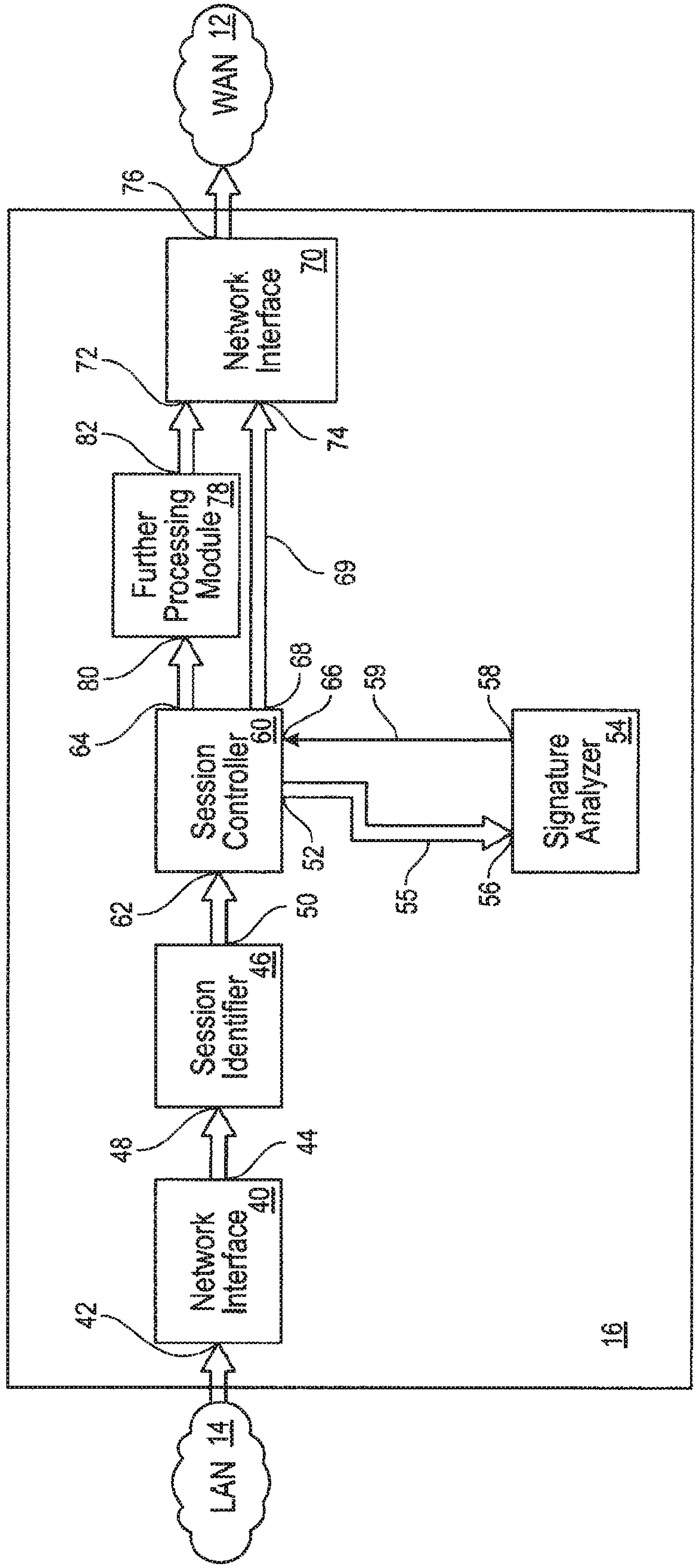
WAN 12
Network Interface 70
Further Processing Module 78
Session Controller 60
Signature Analyzer 54
Session Identifier 46
Network Interface 40
LAN 14
16
76
72
74
82
69
80
64
68
66
59
58
62
52
55
56
50
48
44
42

FIG. 2

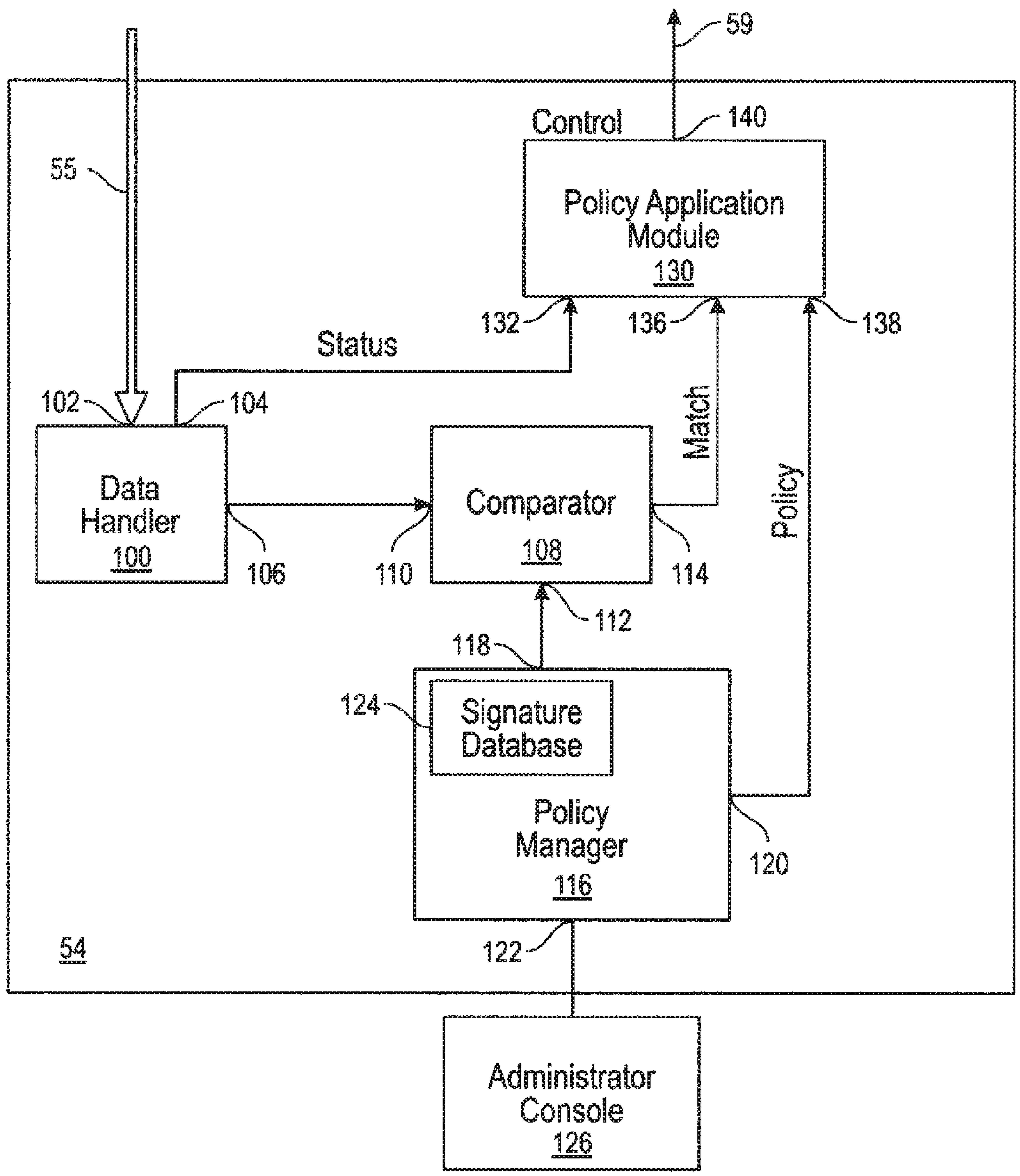
59
Control
140
55
Policy Application Module
130
132
136
138
Status
102
104
Match
Policy
Data Handler
100
Comparator
108
106
110
114
112
118
124
Signature Database
Policy Manager
116
120
54
122
Administrator Console
126

FIG. 3

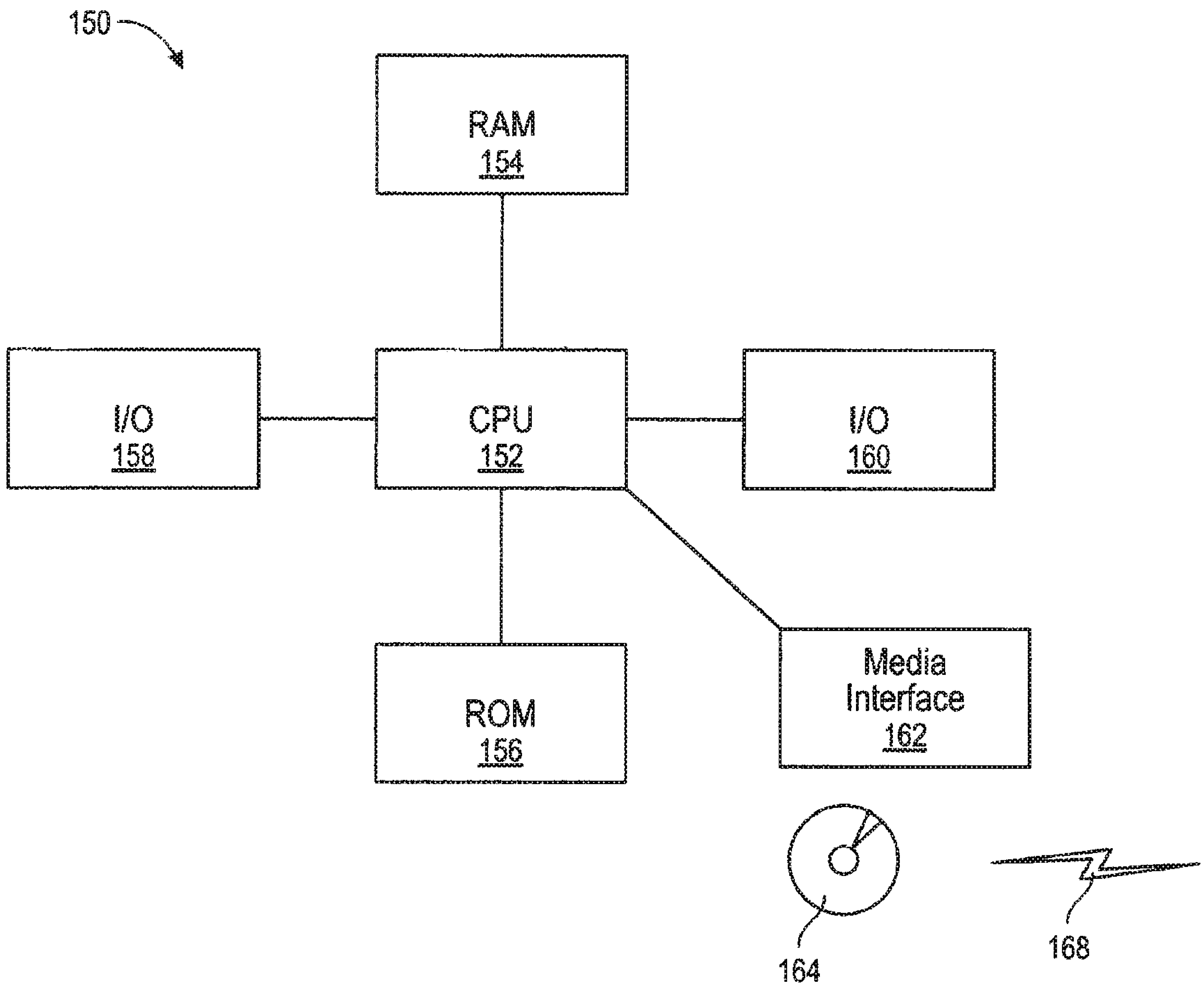
150
RAM
154
I/O
158
CPU
152
I/O
160
ROM
156
Media
Interface
162
164
168

FIG. 4

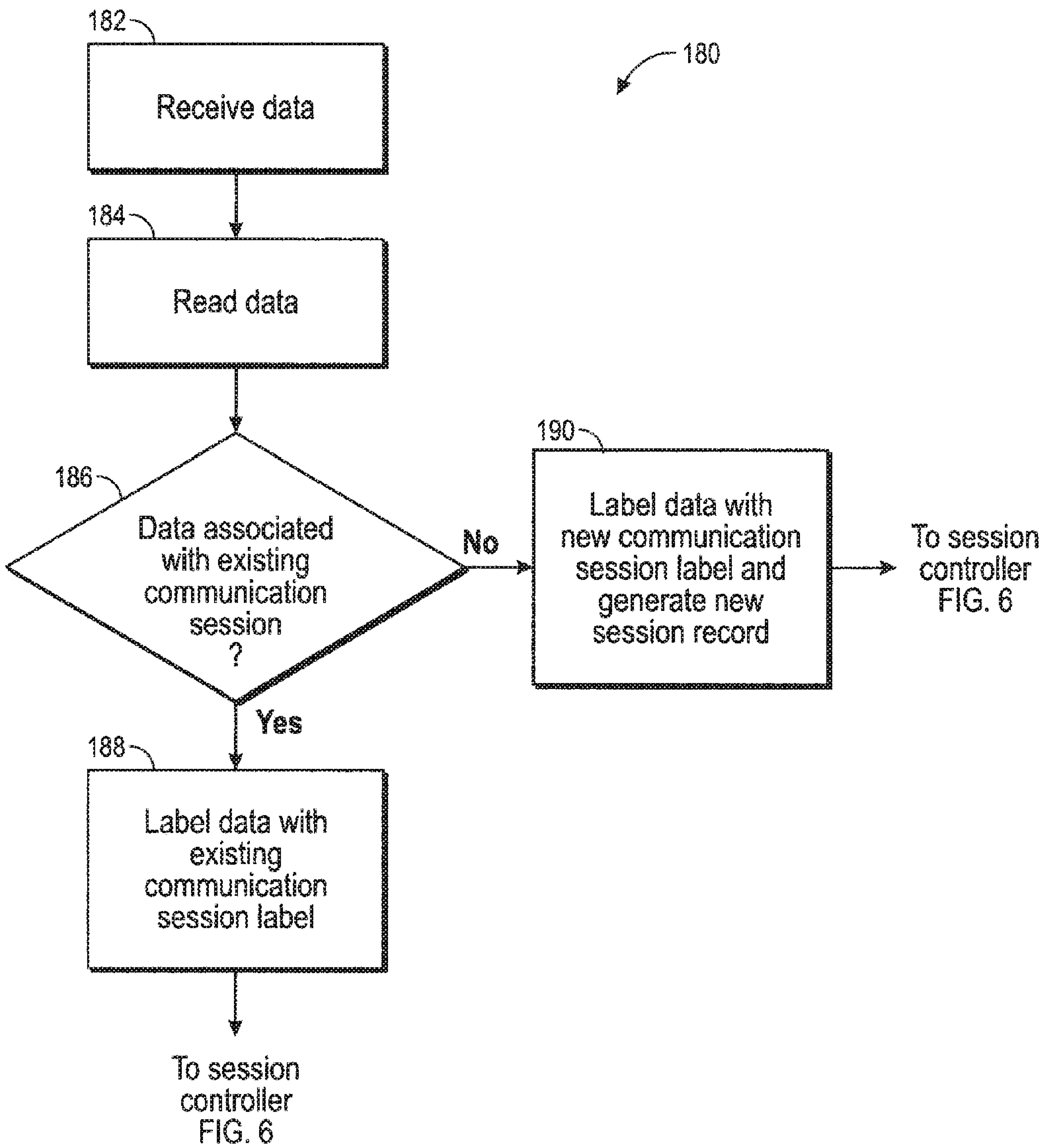
180
182
Receive data
184
Read data
186
Data associated with existing communication session ?
No
190
Label data with new communication session label and generate new session record
To session controller FIG. 6
Yes
188
Label data with existing communication session label
To session controller FIG. 6

FIG. 5

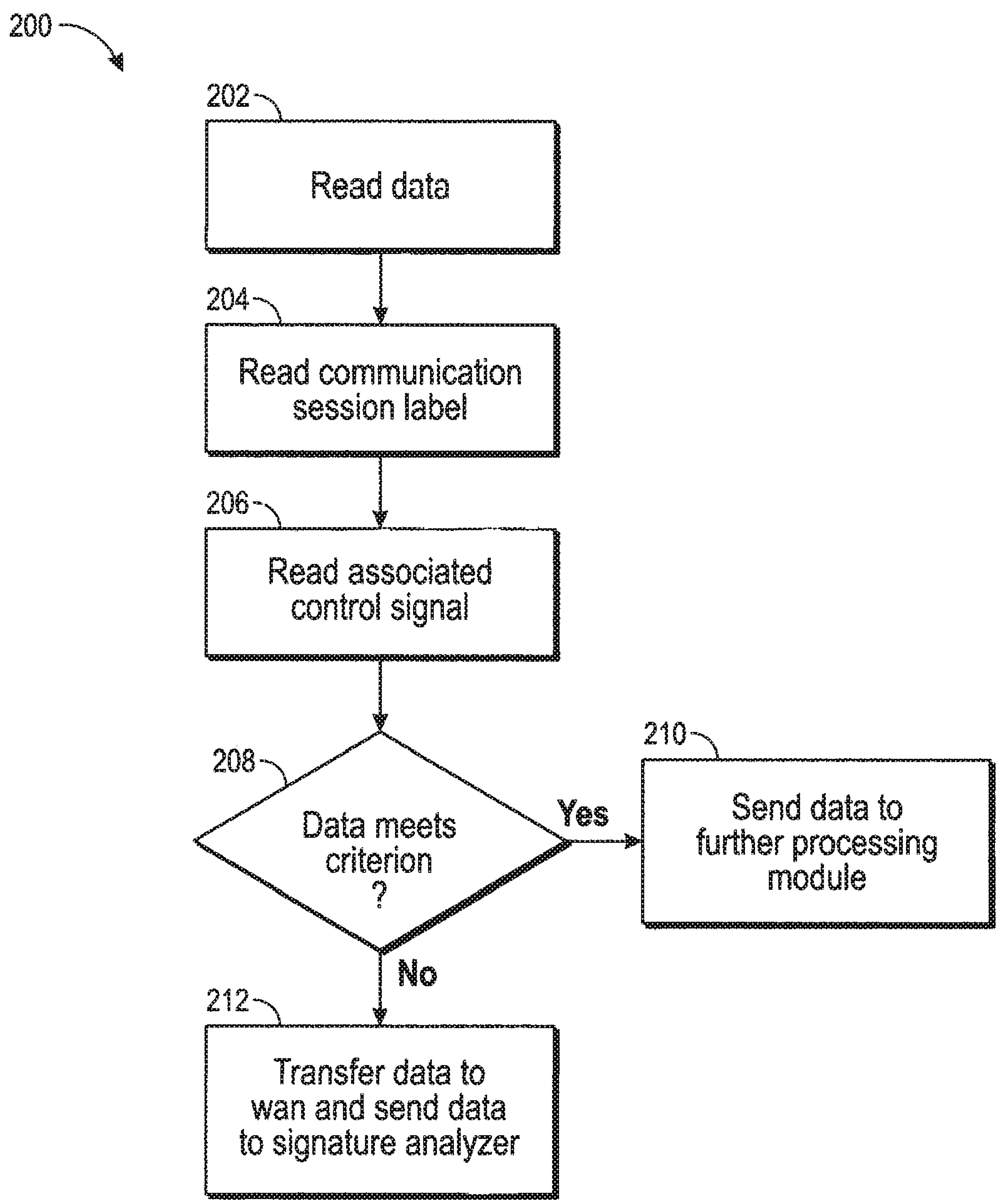
200
202
Read data
204
Read communication session label
206
Read associated control signal
208
Data meets criterion ?
Yes
210
Send data to further processing module
No
212
Transfer data to wan and send data to signature analyzer

FIG. 6

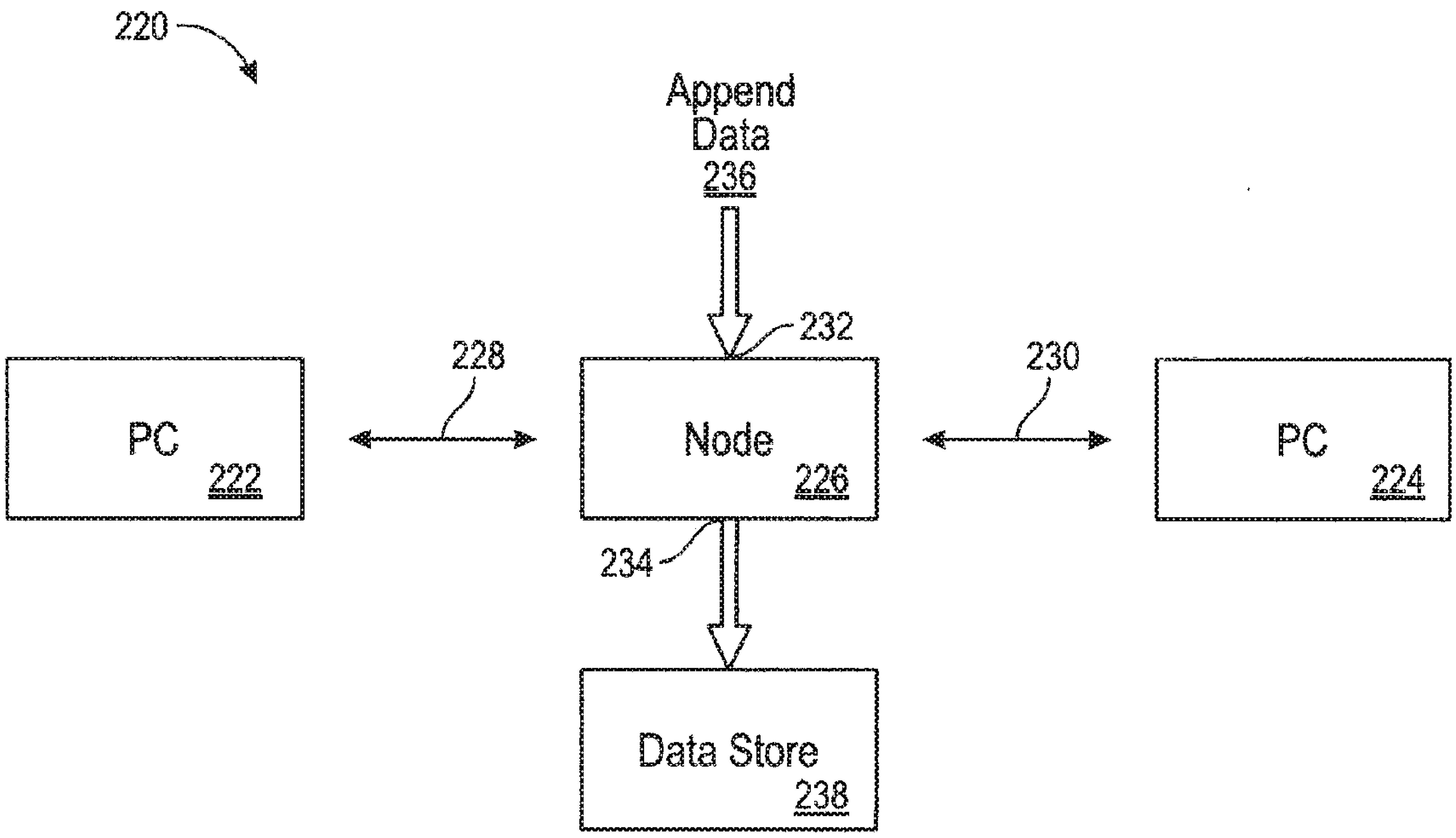
220
Append
Data
236
232
228
230
PC
222
Node
226
PC
224
234
Data Store
238

FIG. 7

| State | Action | Policy | Match | Status |
|---|---|---|---|---|
| 00 | Allow data associated with the communication session to be transferred, while continuing to perform signature analysis on further data associated with the communications session | X | No Match | Not enough data received |
| 01 | Allow data associated with the communication session to be transferred with no further signature analysis | X | No Match | Enough data received |
| 10 | Allow the data associated with the communication session to be transferred after further processing | Log. proxy etc | Match | X |
| 11 | Do not allow the data to be transferred | Drop | Match | X |

(In the above table "X" indicates "don't care")

FIG. 8

# MANAGING TRANSFER OF DATA IN A DATA NETWORK

## RELATED APPLICATION

This application is a continuation of U.S. patent application Ser. No. 14/469,285 filed Aug. 26, 2014, entitled MANAGING TRANSFER OF DATA IN A DATA NETWORK, which claims priority to U.S. patent application Ser. No. 13/250,285 filed on Sep. 30, 2011, entitled METHOD, APPARATUS, SIGNALS, AND MEDIUM FOR MANAGING TRANSFER OF DATA IN A DATA NETWORK now issued U.S. Pat. No. 8,856,884, which claims priority to U.S. patent application Ser. No. 11/220,762 filed on Sep. 6, 2005, entitled METHOD, APPARATUS, SIGNALS, AND MEDIUM FOR MANAGING A TRANSFER OF DATA IN A DATA NETWORK and now issued as U.S. Pat. No. 8,166,547, the disclosures of each being hereby incorporated herein by reference in their entirety.

## BACKGROUND OF THE INVENTION

Field of Invention

This invention relates generally to computer networks and network security, and more particularly to a method, apparatus, signals, and medium for managing a data transfer on a data network.

Description of Related Art

The rapid expansion of high-speed Internet connections and the use of the World Wide Web for commerce, entertainment, and education has provided significant benefits to the global user community. The wide-spread, low cost, and continuous availability of web-based information services has resulted in developments ranging from new business models to portals which provide access to government and education services, to the rapid and free exchange of ideas and information for all members of the Internet community.

Companies have come to increasingly rely on their internal and external networks for information dissemination, service delivery, communications, and data storage, for example. Companies have become particularly vulnerable to disruptions to both internal and external network services. Such disruptions may occur from, for example, malicious code such as computer viruses that may be transmitted via email or other file transfers from an external network. Companies may also need to protect sensitive information in their internal network from access by unauthorized users. At the same time companies have to deal with an ever increasing number of communication and file transfer services, such as instant messaging and peer-to-peer file sharing. The use of such services by employees of a company may expand to occupy a substantial portion of available bandwidth in a company network. Much of the traffic may be frivolous communication, while at the same time distracting workers from assigned tasks.

There is thus a desire to exercise some control over such traffic in both internal and external networks. For example, company policy may dictate that all instant messaging and peer-to-peer traffic between any computer on the company network and any computer outside the company network must be subject to one or more policy rules. Such policy rules may include completely blocking access to certain applications.

Similarly, there may also be a need to monitor and control non-frivolous work-related communications and other data transfers, which may inadvertently subject the internal company network to viruses, intrusion attempts or other unauthorized uses.

While such monitoring and controlling of traffic is in many instances highly desirable, such processes may require the provision of additional computer resources. Depending on the company's network management policies, the monitoring and controlling of data transfers may place a substantial overhead on the operation of the network and may result in unacceptable delays in transferring data from internal to external networks, particularly where there are a large number of network management policies in place.

## SUMMARY

In accordance with one aspect of the invention, there is provided a method for managing a transfer of data between a first node and a second node in a data network. The method involves identifying data associated with a communication session between the first node and the second node. The method also involves further processing the communication session when a portion of the communication session meets a criterion, and permitting the communication session to continue when the portion of the communication session does not meet the criterion.

The transfer of data may involve a plurality of data packets and identifying data associated with the communication session may involve identifying particular data packets associated with the communication session.

Identifying particular data packets associated with the communication session may involve reading data packets transmitted by at least one of the first node and the second node.

Identifying particular data packets associated with the communication session may involve reading a header associated with each of the plurality of data packets.

Reading the header may involve reading and at least one of a source address field, a destination address field, a source port field, a destination port field, and a protocol field.

The method may further involve labeling the particular data packets to indicate that the particular data packets are associated with the communication session.

Labeling the particular data packets may involve associating a data label with the particular data packets.

The method may involve determining whether the data packets comply with an Internet Protocol (IP).

The method may involve determining whether the data packets comply with a Transport Control Protocol (TCP).

The method may involve identifying a signature associated with the data associated with the communication session.

Identifying the signature may involve identifying a pattern in the data associated with the communication session.

Identifying the signature may involve performing signature analysis on the data associated with the communication session.

Identifying the signature may involve determining whether the data associated with the communication session complies with a data transfer protocol.

Identifying the signature may involve determining whether the data associated with the communication session is addressed to a particular destination.

Further processing may involve dropping the communication session.

Further processing may involve at least one of logging at least a portion of the communication session, limiting a bandwidth allocation associated with the communication session, altering at least a portion of the data associated with the communication session, causing a message to be transmitted to at least one of the first node and the second node, configuring a network resource to permit the communication session to proceed, and scanning the data associated with the communication session for data patterns that indicate the presence of malicious code.

Further processing may involve terminating the communication session at a third node and dividing the communication session into a first communication session between the first node and the third node and a second communication session between the third node and the second node, the third node acting as a proxy node.

Permitting the communication session to continue may involve permitting the communication session to continue on a first data transfer path and further processing may involve diverting the communication session to a second data transfer path, the second data transfer path being slower than the first data transfer path.

Permitting the communication session to continue when the portion of the communication session does not meet the criterion may involve permitting a first portion of the communication session to continue while determining whether another portion of the communication session meets the criterion.

The transfer of data may involve a plurality of data packets and permitting a first portion of the communication session to continue may involve permitting a first plurality of data packets associated with the communication session to be transferred while determining whether at least one subsequent data packet associated with the communication session meets the criterion.

The method may involve associating a label with the data associated with the communication session responsive to whether or not the portion of the communication session meets the criterion.

The communication session may be a first communication session and the first communication session may originate a second communication session and the method may involve further processing the second communication session regardless of whether the second communication session meets the criterion.

In accordance with another aspect of the invention, there is provided a computer readable medium encoded with codes for directing a processor circuit to carry out the above method and its variants.

In accordance with another aspect of the invention, there is provided a computer readable signal encoded with codes for directing a processor circuit to carry out the above method and its variants.

In accordance with another aspect of the invention there is provided an apparatus for managing a transfer of data in a data network. The apparatus may include provisions for identifying data associated with a communication session between a first node and a second node in the data network. The apparatus may also include provisions for further processing the communication session when a portion of the communication session meets a criterion, and provisions for permitting the communication session to continue when the portion of the communication session does not meet the criterion.

The transfer of data may include a plurality of data packets and the provisions for identifying data associated with the communication session may include provisions for identifying particular data packets associated with the communication session.

The provisions for identifying particular data packets associated with the communication session may include provisions for reading data packets transmitted by at least one of the first node and the second node.

The provisions for identifying particular data packets associated with the communication session may include provisions for reading a header associated with each of the plurality of data packets.

The provisions for reading the header may include provisions for reading at least one of a source address field, a destination address field, a source port field, a destination port field, and a protocol field.

The apparatus may include provisions for labeling the particular data packets to indicate that the particular data packets are associated with the communication session.

The provisions for labeling the particular data packets may include provisions for associating a data label with the particular data packets.

The apparatus may include provisions for determining whether the data packets comply with an Internet Protocol (IP).

The apparatus may further include provisions for determining whether the data packets comply with a Transport Control Protocol (TCP).

The apparatus may further include provisions for identifying a signature associated with the data associated with the communication session.

The provisions for identifying the signature may include provisions for identifying a pattern in the data associated with the communication session.

The provisions for identifying the signature may include provisions for performing signature analysis on the data associated with the communication session.

The provisions for identifying the signature may include provisions for determining whether the data associated with the communication session complies with a specific data transfer protocol.

The provisions for identifying the signature may include provisions for determining whether the data associated with the communication session is addressed to a specific destination.

The provisions for further processing may include provisions for dropping the communication session.

The provisions for further processing may include at least one of provisions for logging at least a portion of the communication session, provisions for limiting a bandwidth allocation associated with the communication session, provisions for altering at least a portion of the data associated with the communication session, provisions for causing a message to be transmitted to at least one of the first node and the second node, provisions for configuring a network resource to permit the communication session to proceed, and provisions for scanning the data associated with the communication session for data patterns that indicate the presence of malicious code.

The provisions for further processing may include provisions for terminating the communication session at a third node and provisions for dividing the communication session into a first communication session between the first node and the third node and a second communication session between the third node and the second node, the third node acting as a proxy node.

The provisions for permitting the communication session to continue may include provisions for permitting the communication session to continue on a first data transfer path and the provisions for further processing the communication session may include provisions for diverting the communication session to a second data transfer path, the second data transfer path being slower than the first data transfer path.

The provisions for permitting the communication session to continue when the portion of the communication session does not meet the criterion may include provisions for permitting a first portion of the communication session to continue while determining whether another portion of the communication session meets the criterion.

The transfer of data may include a plurality of data packets and the provisions for permitting a first portion of the communication session to continue may include provisions for permitting a first plurality of data packets associated with the communication session to be transferred while determining whether at least one subsequent data packet associated with the communication session meets the criterion.

The communication session may be a first communication session and the first communication session may originate a second communication session and apparatus may include provisions for further processing the communication session regardless of whether the second communication session meets the criterion.

The apparatus may include provisions for associating a label with the data associated with the communication session in accordance with whether the portion of the communication session meets the criterion or does not meet the criterion.

In accordance with another aspect of the invention, there is provided an apparatus for managing a data transfer between a first node and a second node in a data network. The apparatus includes a processor circuit and a memory encoded with codes for directing the processor circuit to perform the above method and its variants.

In accordance with another aspect of the invention, there is provided an apparatus for managing a transfer of data in a data network. The apparatus includes a session identifier operably configured to identify data associated with a communication session between a first node and a second node in the data network. The apparatus further includes a session controller having an input for receiving a control signal indicating whether the communication session meets a criterion. The session controller is responsive to the control signal to produce a signal to indicate whether or not the communication session should be permitted to continue or should be subjected to further processing.

The apparatus may include a signature analyzer operably configured to produce the control signal in response to identifying a signature associated with the data associated with the communication session.

The signature may include a pattern characteristic of a particular type of data transfer.

The signature may include a data protocol identifier.

The signature may include an address field.

The signature analyzer may include a hardware circuit which may include discrete logic components.

The signature analyzer may include an application specific integrated circuit (ASIC).

The apparatus may include a further processing module operably configured to perform the further processing, the further processing module including a third node operably configured to divide the communication session into a first communication session between the first node and the third node and a second communication session between the third node and the second node, the third node acting as a proxy node.

Other aspects and features of the present invention will become apparent to those ordinarily skilled in the art upon review of the following description of specific embodiments of the invention in conjunction with the accompanying figures.

## BRIEF DESCRIPTION OF THE DRAWINGS

In drawings which illustrate embodiments of the invention,

FIG. **1** is a schematic diagram of a data communication system in accordance with one embodiment of the invention;

FIG. **2** is a schematic diagram of one embodiment of a gateway used in the data communication system shown in FIG. **1**;

FIG. **3** is a schematic diagram of one embodiment of a signature analyzer used in the gateway shown in FIG. **2**;

FIG. **4** is a block diagram of a processor circuit for implementing a session identifier used in the gateway shown in FIG. **2**;

FIG. **5** is a flowchart including blocks representing codes executed by the processor circuit of FIG. **4** to implement the session identifier shown in FIG. **2**;

FIG. **6** is a flowchart including blocks representing codes executed by the processor circuit of FIG. **4** to implement a session controller shown in FIG. **2**;

FIG. **7** is a schematic diagram of one embodiment of a further processing module used in the gateway shown in FIG. **2**; and

FIG. **8** is a table of control signals generated by the signature analyzer shown in FIG. **3**.

## DETAILED DESCRIPTION

Referring to FIG. **1**, a data communication system according to a first embodiment of the invention is shown generally at **10**. The system includes a Wide Area Network **12** (WAN), such as an intranet or Internet, a Local Area Network (LAN) **14**, and a gateway **16** connecting the WAN to the LAN. The LAN **14** includes a plurality of nodes shown generally at **18**, which may include networked devices such as personal computers **20** and **22**, but may also include, for example, other devices such as server computers, routers, wireless access points, input devices, and output devices. The WAN **12** also includes a plurality of nodes shown generally at **24**, which may include a server **26** and a personal computer **28**. The server **26** may be an Instant Messaging (IM) mediation server that facilitates an instant messaging data transfer between personal computers **20** and **22** and the personal computer **28**. Alternatively the server may be a computer running a program that receives and processes requests for information from other nodes connected directly to the WAN, such as the personal computer **28**, or nodes connected to the WAN through the gateway **16** and the LAN **14**, such as personal computers **20** and **22**.

Generally the above components cooperate to manage a transfer of data between a first node and a second node in a data network by identifying data associated with a communication session between the first node and the second node and further processing the communication session when a portion of the communication session meets a criterion or permitting the communication session to continue when the portion of the communication session does not meet the criterion.

In one embodiment the transfer of data may include file or message data that has been formatted into one or more data packets. Each data packet includes a header portion and a data portion. The header portion includes fields including information related to the source and/or destination of the data packet. The data portion of the data packet includes the file or message data. If the file or message data is too large to be transmitted in a single packet, it may be split up over several packets, in which case the header portion may also include information related to the sequence of the data packets thus facilitating correct re-assembly of the file or message data at the destination.

The gateway **16** manages the transfer of data packets between the LAN **14** and the WAN **12** and is shown in greater detail in FIG. **2**. The gateway includes a network interface **40**, which includes an input **42** and a data output **44**. The input **42** is in communication with the LAN **14**. The network interface **40** includes circuitry that receives signals representing data packets to be transferred at the input **42** and converts the signals into data packets at the data output **44**. In one embodiment the data at the data output **44** may be data packets formatted in accordance with the Internet Protocol (IP). The network interface **40** may be an Ethernet interface or a wireless interface, or any other network interface that facilitates the transfer of data between nodes in a data communication system.

The gateway **16** further includes a session identifier **46**, which includes a data input **48** and a data output **50**. The data input **48** is in communication with the data output **44** of the network interface **40**. The session identifier **46** receives data packets at the data input **48** and reads the data packets to identify which packets should be associated with a communication session, before forwarding the data packets on to the data output **50**.

A communication session involves the exchange of data packets between nodes that are in communication over a data network. For example, Transmission Control Protocol (TCP) data transfers allow a communication session to be established between a first node and a second node. TCP communication sessions include session establishment, a data transfer, and session termination. The session establishment takes place via a three-way handshake before the actual data transfer is able to proceed. During the session establishment, parameters such as sequence numbers are initialized to help ensure ordered and robust delivery of data packets. Termination of a TCP session takes place via a four-way handshake. TCP data packets include a TCP header and a data portion. The header portion includes information such as a source port and a destination port. Details of the Transmission Control Protocol are contained in the document "RFC: 793: TRANSMISSION CONTROL PROTOCOL, DARPA INTERNET PROGRAM, PROTOCOL SPECIFICATION, September 1981", which is incorporated herein by reference.

In contrast, some data transfer protocols, such as the Internet Protocol (IP), provide almost no guarantees in respect of delivery of the data packet, which may arrive damaged, out of order, may be duplicated, or may have been dropped entirely. When sending IP data packets from a first node to a second node, which have not previously communicated, no prior setup is required. Accordingly, the Internet Protocol does not provide for the establishment of a communication session, and if reliable data transfer is required, it may be provided by transporting data according to an upper level protocol. For example, TCP data packets may be transported in the data portion of an IP data packet, in which case the data transfer is referred to as TCP over IP or TCP/IP. Details of the Internet Protocol are contained in the document "RFC: 791: INTERNET PROTOCOL, DARPA INTERNET PROGRAM, PROTOCOL SPECIFICATION, September 1981", which is incorporated herein by reference.

The gateway **16** further includes a session controller **60**, which includes a data input **62**, a control signal input **66**, and first, second and third data outputs **52**, **64** and **68**. The session controller **60** receives data packets from the data output **50** of the session identifier **46** and forwards the data packets to one or more of the first, second and third data outputs **52**, **64** and **68** in response to a control signal received at the control signal input **66**.

The gateway **16** also includes a signature analyzer **54**, which includes a data input **56** and a control signal output **58**. The data input **56** is in communication with the data output **52** from the session controller **60**, via a data line **55**. The control signal output **58** is in communication with the control signal input **66** of the session controller **60**, via a control signal line **59**. The signature analyzer **54** receives data packets from the session controller **60** at the data input **56** and determines whether any portion of the data packets meets a criterion. The signature analyzer produces a control signal at the control signal output **58**, which indicates whether or not a particular data packet meets the criterion.

The signature analyzer **54** is shown in greater detail in FIG. **3**. The signature analyzer **54** includes a data handler **100**, which includes a data input **102**, an output **104** for producing a status signal, and a data output **106**. The data handler **100** receives data packets from the session identifier **46** at the data input **102**, and performs functions such as data packet re-assembly.

The signature analyzer **54** also includes a policy manager **116**, which includes a signature database **124** for storing a plurality of data signatures. Each signature stored in the signature database **124** may include a data pattern that is characteristic of a particular type of data transfer. A signature may also include user names, source or destination addresses, source or destination ports, or a protocol identifier, for example. In this embodiment the criterion is met for a particular communication session when any of the signatures stored in the signature database match data associated with the particular communication session.

In one embodiment the signature database **124** may also store a plurality of policies to be followed in the event of a match to a particular signature, in which case each signature stored in the signature database includes an associated policy, which may also be stored in the signature database. The policy manager **116** also includes a signature signal output **118** for producing signature signals and a policy signal output **120** for producing policy signals representing the signatures and policies stored in the signature database **124**.

The policy manager **116** also includes a communication port **122**, which facilitates connection to the policy manager **116** by a system administrator via an administrator console **126** for updating or maintenance of network management policies and/or signatures. The communication port **122** may be a connection to a LAN.

In this embodiment the signature analyzer **54** includes a comparator **108**, which includes a data input **110**, a signature input **112**, and a match signal output **114**. The comparator **108** receives data at the data input **110** from the data output **106** of the data handler **100**, and compares the data to signatures received on the signature input **112**. The comparator **108** produces a match signal at the output **114** when a signature matches any portion of the data received at the data input **110**, thus indicating that data associated with the communication session meets the criterion.

The signature analyzer **54** also includes a policy application module **130**, which includes a first input **132** for receiving the status signal from the data handler **100**, a second input **136** for receiving the match signal from the comparator **108**, and a third input **138** for receiving the policy signal from the policy manager **116**. The policy application module **130** also includes an output **140** for producing the control signal on the control signal line **59**. The policy application module functions to produce a control signal at the output **140** in response to the status signal, the match signal, and the policy signal received on the first, second and third inputs **132**, **136**, and **138** respectively.

In one embodiment the signature analyzer **54** may be partly or fully implemented using a hardware logic circuit including discrete logic circuits and/or an application specific integrated circuit (ASIC). Alternatively the signature analyzer **54** may be implemented using a processor circuit.

Referring back to FIG. **2**, the gateway **16** also includes a further processing module **78**, which includes a data input **80**. The data input **80** is in communication with the data output **64** of the session controller **60**. The further processing module **78** receives data packets from the session controller **60** when the control signal indicates that the data packets associated with the communication session meet the criterion. The further processing module **78** performs one or more further processing functions on the data packets, such as logging the data packets. In one embodiment the further processing module **78** simply drops the data packets after they have been logged (i.e. does not forward the data packets on). In another embodiment the further processing module **78** may include a data output **82** for forwarding the data packets after performing the further processing.

The gateway **16** further includes a network interface **70**, which includes first and second data inputs **74** and **72** and a data output **76**. The first data input **74** is in direct communication with the data output **68** of the session controller **60** via a fast data transfer path **69**. In one embodiment, the data input **72** is in communication with the data output **82** of the further processing module **78** and may receive data packets from the session controller **60** after they have been processed by the further processing module **78**. The data output **76** of the network interface **70** is in communication with the WAN **12**. The network interface **70** receives data packets at either of the first and second data inputs **74** and **72** and converts the data packets into signals representing the data packets, thus facilitating transmission of the data packets over the WAN **12**.

Referring to FIG. **2**, the session identifier **46** may be implemented using a processor circuit shown generally at **150** in FIG. **4**. Referring to FIG. **4** the processor circuit **150** includes a central processing unit (CPU) **152**, a random access memory (RAM) **154**, a read-only memory (ROM) **156**, and input/output interfaces (I/O) **158** and **160**. The processor circuit also includes a media interface **162**, which facilitates loading program codes into the ROM **156** or the RAM **154** from a computer readable medium **164**, such as a CD ROM, or from a computer readable signal **168**, such as provided by an Internet connection, for directing the processor circuit to carry out functions according to a method associated with one aspect of the invention.

A flowchart depicting blocks of code for causing the processor circuit **150** to implement the session identifier **46** is shown in FIG. **5** at **180**. The blocks generally represent code that may be stored in the RAM **154** or the ROM **156** for directing the CPU **152** to carry out a session identifier process. The actual code to implement each block may be written in any suitable programming language such as C, C++, and/or assembler code, for example.

The process begins with a first block of codes **182**, which directs the CPU **152** to cause the I/O **158** to receive a data packet from the network interface **40** and to store the data packet in the RAM **154**.

Block **184** then directs the CPU **152** to read a portion of the data packet to determine whether the data packet should be associated with a communication session. For example, where the data packet is transferred using IP, a communication session may be partially identified by reading an IP source address field and an IP destination address field in the data packet header portion, to uniquely identify data packets being transferred between a first node and a second node.

However, IP data transfers between the nodes at the source address and the destination address may include several different communication sessions, such as TCP communication sessions, or other data transfers according to protocols that do not implement communication sessions at all. In this case it is necessary to determine what protocol the data in the IP data packet portion complies with.

The protocol may be determined by reading an IP protocol identifier field in the IP data packet header (which may have the value "6" for a TCP data transfer for example). Once the data transfer protocol is established, the existence of a communication session may be determined by reading appropriate fields in the IP data portion. For example, where the IP data portion complies with the Transmission Control Protocol, a TCP source port, and a TCP destination port may be read to uniquely identify a communication session between the first and second nodes. The various fields that are read to determine whether the data should be associated with a communication session are hereinafter referred to session identification fields.

Returning to FIG. **5**, the block **184** directs the CPU **152** to read the session identification fields in the data packet being transferred. In one embodiment the CPU **152** maintains a session table (not shown) in the RAM **154**, which records details of all active communication sessions. The session table includes a session record for each active communication session. The session record includes session identification fields such as the IP source and destination addresses, the IP protocol field, TCP source and destination ports, and any other fields that may be used to identify a communication session under a particular data transfer protocol. Each session record also includes a field for storing a unique communication session label which uniquely identifies a corresponding communication session. The unique communication session label may be a number from a series of arbitrary numbers.

Block **186** directs the CPU **152** to compare the session identification fields for the data packet being transferred to session records in the session table. If the data packet includes session identification fields that correspond to fields in a session record for an existing communication session included in the session table, the CPU is directed to block **188**. Block **188** directs the CPU **152** to label the data packet with the communication session label corresponding to the session record. For example, the label may be associated with the data packet by appending the label to the data packet.

If the communication session does not yet exist, the CPU **152** is directed to block **190**, which causes it to add a new session record to the session table. The new session record includes a new communication session label and the session identification fields for the data packet being transferred. Block **190** also directs the CPU **152** to label the data packet with the corresponding new communication session label.

The operation of the signature analyzer **54** is described in relation to FIG. **2** and FIG. **3**. The signature analyzer **54** receives a data packet, which has been labeled with a unique communication session label, from the session controller **60**, at the data input **102** of the data hander **100**. In one embodiment, where the data has been split and transferred in a plurality of data packets, the data handler **100** may re-assemble the data packets into order, and may re-combine at least a portion of the data packets so that the signature analyzer **54** will be able determine whether data spanning one or more data packets meets the criterion. The data handler **100** produces a status signal at the output **104**. The status signal includes a representation of the unique communication session label and other information relating to the data packets received. For example, the status signal may include information relating to a count of the number of data packets received for a particular communication session. The status signal may also include an indication of whether sufficient data has been received to perform signature analysis. For example, the status signal may be used to indicate that a pre-determined number of bytes have been received by the data handler **100**. The data handler **100** then forwards the re-assembled data to the data input **110** of the comparator **108**.

The comparator **108** temporarily stores a copy of the data, which may include data from a single data packet or a plurality of data packets. The policy manager **116** functions to look up a signature in the signature database **124**, and produces a signature signal at the signature signal output **118** corresponding to the signature. Generally the signature database **124** includes a plurality of signatures and the policy manager **116** sequentially looks up each signature and produces corresponding signature signals. The comparator **108** compares the temporarily stored data to the signature signals received from the policy manager **116** at the signature input **112** of the comparator. If a signature matches a portion of the temporarily stored data received at the data input **110**, the comparator **108** produces a match signal at the match signal output **114** indicating that a match has been found in the data.

The policy signal includes an indication of a policy action to be performed in the event of a match between the data received at the data input **110** and a particular signature received at the signature input **112**. In one embodiment a policy action is associated with each signature and the policy action and signature are stored in the signature database **124**, thus allowing different actions to be undertaken depending on the signature that is found in the data.

In one embodiment the policy application module **130** combines the status signal received at the input **132**, the match signal received at the input **136**, and the policy signal received at the input **138** and produces the control signal at the output **140**. In this embodiment the control signal includes four possible states as listed in the table shown in FIG. **8**.

The state 00 is assigned by the policy application module **130** when the match signal indicates that no match has yet been found and the status signal indicates that sufficient data packets have not yet been analyzed by the signature analyzer **54** in order to determine whether the data associated with the communication session meets the criteria.

The state 01 is assigned by the policy application module **130** when the match signal indicates that no match has yet been found and the status signal indicates that sufficient data packets have been analyzed by the signature analyzer **54** to consider the communication session safe. In this case signature analysis of the communication session may be discontinued and the signature analyzer **54** no longer needs to receive data packets associated with the communication session.

The state 10 is assigned by the policy application module **130** when the match signal indicates that a match has been found and the policy signal indicates that the communication session should be further processed in the further processing module **78**. Such further processing is described later.

The state 11 is assigned by the policy application module **130** when the match signal indicates that a match has been found and the policy signal indicates that the communication session should be dropped (i.e. no further data packets should be transferred). In this case the data may be erased from the RAM **154**, or may be transferred to the further processing module **78**, where it may be logged, but not transferred.

Referring to FIG. **2**, the session controller **60** may also be implemented using the processor circuit **150**. A flowchart depicting blocks of code for causing the processor circuit **150** to implement the session controller **60** in the processor circuit **150** is shown in FIG. **6** at **200**. Block **202** directs the CPU **152** to read a data packet from the RAM **154**. Block **204** directs the CPU **152** to read the communication session label associated with the data packet.

In one embodiment control signals may be asynchronously received by the session controller as the results of the signature analysis by the signature analyzer **54** become available. Accordingly, when each successive control signal is received at the control signal input **66**, the associated communication session label is read and the control signal is stored in a field in the session record corresponding to the communication session label.

If the communication session is a new communication session, an associated control signal may not yet be available from the signature analyzer **54**. Accordingly, when a new session record is generated for a new communication session by the session identifier **46**, the control signal field is initially set to the "00" state, indicating that the communication session does not meet the criterion. Once a control signal for the new communication session is available, the control signal field in the session record is overwritten, in which case the control signal field may change state after a number of data packets have been analyzed by the signature analyzer **54**.

Block **206** directs the CPU **152** to read the control signal from the session table record corresponding to the communication session label for the data packet. Block **208** directs the CPU **152** to determine whether the communication session meets the criterion, as indicated by the control signal state "10" or "11" in the table of FIG. **8**. If the data associated with the communication session does meet the criterion, block **210** directs the CPU **152** to send the data to the further processing module **78**. If the control signal state is "11", the further processing module **78** drops the communication session by for example, erasing the data packet from the RAM **154**.

Alternatively if the control signal state is "10" the further processing module **78** performs some other action. For example the further processing module **78** may cause a log to be made of all, or a portion of the data packets associated with the communication session. The log may be stored in memory for later analysis. The further processing module **78** may limit a bandwidth allocation associated with said communication session so that certain types of traffic (such as instant messaging traffic) will not be permitted to exceed a pre-determined portion of the network bandwidth. The further processing module **78** may also alter data packets associated with the communication session to insert a message or remove certain data. The message may be transmitted to source and/or destination nodes and may indicate that the transfer is subject to restriction in accordance with a network management policy.

Alternatively, in order to proceed, the communication session may require a network resource to be specifically configured. For example, the further processing module **78** may cause a specific TCP port to be temporarily opened, thus permitting a communication session that would not ordinarily be allowed, to proceed.

In one embodiment the further processing module **78** may cause data packets associated with the communication session to be virus scanned to detect the presence of malicious code that may threaten the integrity of the network. Data packets associated with communication sessions that do not meet the criterion may not be scanned for malicious code or may be scanned to a different extent than communication sessions that are diverted to the further processing module **78**. Alternatively, out of an abundance of caution, all data packets associated with the communication session may be virus scanned regardless of whether or not the communication session does or does not meet the criterion.

In some cases a communication session may give rise to another communication session. For example an ongoing instant messaging session may initiate a file transfer in a separate communication session. In such cases, where an original communication session has already been determined to meet the criterion and has been diverted to the further processing module **78**, the separate communication session may also be diverted to the further processing module **78** without performing signature analysis on data packets associated with the separate communication session.

Returning to FIG. **6**, if the data associated with the communication session does not meet the criterion (indicated by the control signal state "00" or "01"), block **208** directs the CPU **152** to block **212** where the CPU **152** causes the I/O **160** to write the data packet to the data output **68**, which is in communication with the data input **74** of the network interface **70**. The network interface **70** then converts the data into data signals and transmits the data over the WAN **12**. If the control signal state is "01", a remaining portion of the communication session is considered safe and permitted to proceed along the fast data path **69**.

If the control signal state is "00", block **212** also directs the CPU **152** to permit the communication session to proceed along the fast data path **69**, but the session controller **60** continues to forward data packets associated with the communication session to the signature analyzer **54**. Thus, the communication session is initially permitted to proceed pending a determination by the signature analyzer **54** as to whether subsequently transferred data packets meet the criterion, in which case a further processing action will be performed.

In another embodiment the session controller **60** may be implemented using a separate processor circuit such as that shown at **150** in FIG. **4**. In this case, once the session identifier **46** has labeled the data packets with a communication session label the data packets are written out via the I/O **160**. The separate processor circuit then receives the data packets on an I/O interface and stores the data packets in RAM memory.

Referring to FIG. **7**, one embodiment of the further processing module is shown at **220**. The further processing module **220** includes a proxy node **226** which is in communication with a data store **238**. The proxy node **226** performs a logical splitting of a communication session between a first PC **222** and a second PC **224**, thus forming a first logical communication session indicated by the arrow **228** and a second logical communication session indicated by the arrow **230**. The proxy node **226** performs a mapping of IP source and destination addresses, TCP source and destination ports, and data contained in TCP data packet data portions, such that PC's **222** and **224** are unaware of the logical splitting of the communication session by the proxy node **226**. The proxy node **226** includes a data input **232** for receiving append data **236** which is inserted into data packets being transferred through the node **226** causing a message to be displayed at the PC **222** and/or PC **224** indicating that the users are not permitted to transfer such data. The proxy node **226** also includes a data output **234** which is coupled to the data store **238** for forwarding copies of the data packets, or a portion thereof, to a data store **238**. The data store **238** may be a simple storage medium for storing data in an accessible format but may also include facilities for performing statistical or other analysis on the data transfers, for example.

Advantageously, the data associated with a communication session is initially transferred from the network interface **40** to the session identifier **46**, the session controller **60**, through the network interface **70** and out onto the WAN **12**. In this embodiment, the session controller **60** does not wait for the signature analyzer **54** to complete the signature analysis and produce the control signal. Thus the data transfer is initially allowed to proceed without undue delay on the fast data transfer path **69** between the data output **68** of the session controller **60** and the data input **74** of the network interface **70**. The processes implemented in the session identifier **46** and the session controller **60** may be simple and fast, requiring reading and comparison of a small number of fields from the headers of the data packets to identify and determine how to handle data associated with a communication session.

In contrast, depending on the policy in place in the gateway **16** the signature database **124** may include a large number of signatures. Consequently, in this embodiment the process implements a network management policy that initially assumes that communication sessions are safe, as would be the case in a large proportion of data transfers, and then determines whether the communication session should be subjected to further processing or dropped.

The communication session has been described in relation to a TCP/IP communication session. However, other protocols such as User Datagram Protocol (UDP) may also support communication sessions through a higher level protocol that uses UDP for data transfer. Examples of some higher level protocols that support communication sessions include Domain Name Server (DNS), eDonkey, BitTorrent, and Real-Time Transport Protocol (RTP). For example DNS responses and requests include an ID field for indicating which response matches which request.

While the process is described in relation to an outbound data transfer as depicted in FIG. **2**, it should be understood that a communication session will generally include both outbound and inbound data transfers and that both inbound and outbound data may be received by the session identifier **46** and processed as described above.

While specific embodiments of the invention have been described and illustrated, such embodiments should be considered illustrative of the invention only and not as limiting the invention as construed in accordance with the accompanying claims.

What is claimed is:

1. A network gateway device, implemented at least partially in hardware, for managing a transfer of data over the data network, the network gateway device comprising:

a processor;

a signature analyzer comprising a policy manager to store policies and associated signatures, including a first policy that diverts data transfers between a plurality of nodes on the data network to a proxy server which scans for malicious code associated with at least one signature;

a network interface, communicatively coupled to the processor and the data network, to receive packets transmitted between the plurality of nodes of the data network;

a session identifier communicatively coupled to receive the packet from the network interface and to identify data associated with a first communication session between a first node and a second node of the data network,

wherein the signature analyzer further comprises a comparator, the signature analyzer to receive the identified data of the first communication session and the comparator comparing the identified data against signatures from a signature database, the signature analyzer to produce a control signal responsive to a policy associated with a signature matching the identified data; and

a session controller, responsive to receiving the control signal indicating the signature match, to perform further processing of the identified data, and responsive to the second input not receiving the control signal, the session controller sending the identified data over the second output without further processing.

2. The network gateway device of claim 1, wherein the signature analyzer does not produce the control signal if the amount of identified data received falls below a predetermined threshold, wherein the signature analyzer produces the control signal responsive to receiving enough data to meet the predetermined threshold in addition to finding the signature match.

3. The network gateway device of claim 1, wherein the signature analyzer does not produce the control signal responsive to not finding a signature matching the identified data, thereby allowing the data transfer without further processing.

4. The network gateway device of claim 1, wherein the signature analyzer produces the control signal comprising a first control signal, wherein the session controller further processes the identified data by dropping associated packets.

5. The network gateway device of claim 1, wherein the signature analyzer produces the control signal comprising a second control signal, wherein the session controller further processes the identified data by sending associated packets from the first node to the proxy server for virus scanning prior to forwarding to the second node.

6. The network gateway device of claim 1, wherein the session identifier identifies a second communication session that is distinct from the first communication session but is determined to be related to the first communication session, wherein the signature analyzer applies the first policy associated with the identified data of the first communication session.

7. The network gateway device of claim 1, wherein the signature comprises a pattern characteristic of a particular type of data transfer.

8. The network gateway device of claim 1, wherein said signature comprises a data protocol identifier.

9. The network gateway device of claim 1, wherein the signature comprises an address field.

10. The network gateway device of claim 1, wherein the signature analyzer comprises a hardware circuit comprising discrete logic components.

11. The network gateway device of claim 1, wherein the signature analyzer comprises an application specific integrated circuit (ASIC).

12. A computer-implemented method in a network gateway device, for managing a transfer of data over the data network, the method comprising:

storing policies and associated signatures in a policy manager of the gateway device, including a first policy that diverts data transfers between a plurality of nodes on the data network to a proxy server which scans for malicious code associated with at least one signature;

receiving, at a network interface of the network gateway device, packets transmitted between the plurality of nodes of the data network;

receiving, in a session identifier of the network gateway device, the packet from the network interface and identifying data associated with a first communication session between a first node and a second node of the data network,

receiving the identified data of the first communication session and comparing the identified data against signatures from a signature database with a comparator

producing a control signal responsive to a policy associated with a signature matching the identified data; and

responsive to receiving the control signal indicating the signature match, performing further processing of the identified data, and responsive to the second input not receiving the control signal, sending the identified data over the second output without further processing.

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